

Indoor Air Quality (IAQ) Preventative Maintenance Guidelines and Complaint Procedures for DPW Properties

The purpose of this document is to set up guidelines and procedures that may help in preventing, addressing and documenting IAQ complaints at DPW facilities. Key elements are:

- A. Preventative maintenance of HVAC systems and building components that may affect IAQ.
- B. IAQ Complaint Procedures to include
Logging/record keeping, communication with occupant/s, actions to be taken in response to complaints, hypothesis testing.

A. PREVENTATIVE MAINTENANCE (PM)

Performing routine PM on and inspections of building and mechanical system components can reduce or eliminate IAQ complaints. Documentation of related PM tasks should be maintained on file. The attached "Ventilation Log" (with instruction) and "HVAC Checklist-short form" can be used to document preventative maintenance activities and serve as useful tools in resolving many IAQ complaints.

1. HVAC systems should be maintained to provide the following IAQ parameters (or most current applicable ASHRAE guideline or OSHA Standard):

<u>IAQ parameters</u>	<u>Range</u>
Fresh Air Make-up	20 CFM per occupant (Verify thermostats are set to have fans run continuously, not on auto.)
Carbon Dioxide or CO ₂	less than 1000 ppm
Carbon Monoxide or CO	< 35 ppm (with proper fresh air make up, placement of air intakes and proper venting of any fuel burning equipment, CO should easily be maintained below this value.)
Temperature in F	68 – 78F (less than 75 F during winter months)
Relative Humidity	30-50% (we do not expect or want to mechanically control humidity/levels outside of this range when due to seasonal weather conditions)

2. Preventative maintenance should include the following:

- Check damper positions and functioning belts, baffles, ductwork, and system balance (as needed or as warranted re-balancing of the system can prevent inflow or outflow of contaminated air due to pressure differentials between rooms).
- Check IAQ parameters and perform adjustments as needed to meet guidelines/standards.
- Replace filters on air handling units at regular intervals.
- Clean air distribution ducts and dampers if necessary.
- Replace any damaged insulation.
- Periodic inspections for partitions or obstructions that might block fresh-air flow.
- Eliminate or control all known and potential sources of microbial contaminants by **prompt** cleanup and repair of all areas where water collection and leakage has occurred including floors, roofs, HVAC cooling coils, drain pans, humidifiers containing reservoirs of stagnant water, air washers, fan coil units, and filters
- Periodic inspections of outside air intakes to ensure there are no potential sources of contamination (automobile garages, cooling towers, building exhausts, roadways) in close proximity. If they are, air filtration/conditioning may be required or relocation necessary.
- Remove and discard porous organic materials that are contaminated (e.g., damp insulation in ventilation system, moldy ceiling tiles, and mildewed carpets).
- Clean and disinfect nonporous surfaces where microbial growth has occurred with detergents, chlorine-generating slimicides, or other biocides and insuring that these cleaners have been removed before air handling units are turned on.
- Adjust combustion sources such as furnaces or water heaters to assure proper burning and exhaust to an area where re-entrainment will not occur.

3. Practices to follow during construction, renovation, demolition (painting, carpet laying etc.) activities:

- Keep any affected building occupants informed of construction activities.

- Material Safety Data Sheets (MSDS) of materials used or installed during construction should be made available. Application of and curing of any odorous materials such as glues, adhesives, paints, etc., should be vented separately to the outdoors not near any air intake ducts when necessary.
- The air handling systems for occupied spaces should be entirely isolated from the construction area whenever possible.
- Barriers should be installed to isolate construction activities to prevent dust intrusion into the occupied space and to minimize noise.
- Employ work practices that will ensure compliance with asbestos regulations such as the CT Public Health Code, OSHA and the Federal National Emission Standards for Hazardous Air Pollutants to include analyzing suspect or presumed asbestos containing materials that will be disturbed by construction activities to determine if abatement is necessary.
- Employ work practices that will ensure compliance with OSHA lead standard.
- Air handling unit filters should be replaced as needed during construction and after construction. Ductwork and system components must be inspected following construction activities and cleaned or maintained as needed.
- Ensure no construction/ renovation activities will affect proper heating, ventilation and air conditioning of any workspace and that any new system components or changes to the existing system will satisfy ASHRAE guidelines.

B. PROCEDURES IN RESPONSE TO IAQ COMPLAINTS

1. **Log complaint.** On-site property managers should maintain a log/file of a IAQ complaints to include dates, times, name/s and telephone number/s of occupant/s who filed the complaint, the nature of complaint as well as the date and time of response to each complaint, investigative and corrective actions and date of communication with occupant/s once IAQ issue is resolved. A copy of IAQ logs should be maintained on file at the premise and made available to DPW or tenant upon request. See some examples of forms attached that may be useful: "Indoor Air Quality Complaint Form" and "Incident Log".
2. **Perform an initial walk through of the area** and consult with /interview occupant/s who initiated the complaint. See below for suggested information to gather from occupant. Document your discussion with occupant/s. If situation warrants, have occupant maintain a diary of symptoms regarding IAQ issues. See attached for examples of forms that may be useful: "Occupant Interview Form" and "Occupant Diary".
Suggested information to obtain from occupant interviews:
 - a. What are the complaints and associated symptoms if any experienced; when do they occur (season, time, days, frequency); where do they occur; how long do any symptoms last; do they clear up after leaving work (how soon); have the symptoms been triggered by any specific event or in any specific area; what is the source of symptoms; was any medical diagnosis or care rendered?
 - b. Are there any occupational contributors?
3. If the source of problem is readily identifiable from the initial walk through or interview, take corrective actions and inform occupants of actions. Document communication and actions.
4. If the source of the problem is not readily identifiable from the initial walk through or interview but there are **potential explanations** for the complaint, **systematically check each hypothesis**, correct the problem if possible and inform occupants of corrective actions. Typical causes of IAQ complaints and some suggested corrective actions to minimize IAQ issues are listed below. Document hypothesis and results of test. See example of forms attached that may be useful: "Hypothesis Form"; "Pollutant and Source Inventory"; "Chemical Inventory"; "Zone/Room Record"; "Log of Activities and System Operations"; "Pollutant Pathway

Record for IAQ Profiles"; and "Pollutant Pathway Form for Investigations".

Typical causes of IAQ complaints and some suggested corrective actions to minimize IAQ issues:

- a. Are there sources of indoor contaminants that could lead to employee complaints such as copy machines, blueprint copiers, paints, cleaning compounds and disinfectants, tobacco smoke, adhesives and glues, off-gassing of construction material and building fabric, contaminants generated by construction or renovation, positive- or negative-pressure work areas, improperly vented gas appliances, air fresheners, pesticides?
- b. *Are there sources of outdoor contaminants that lead to employee complaints such as vehicle exhaust, roofing materials, cooling towers, dust, or other contaminants from construction activity, industrial plant, or building exhaust; gasoline vapors, pollen, biological contaminants, atmospheric pollutants?
- c. *Are HVAC systems being operated and maintained properly with respect to: location of air intakes and exhausts, pressure differentials between rooms that may account for influx of contaminants, design for supplied outdoor air, flow and distribution of air, position of dampers and air vents (are they open?), HVAC operating times, regular operation checks, equipment cleaning and disinfecting, presence of water leaks or standing water, water-damaged building materials, and bacteriological contamination?

*** NOTE: RUN THROUGH ALL ITEMS ON THE "VENTILATION LOG" IN COMBINATION WITH THE "HVAC CHECKLIST -SHORTFORM".**

5. If source of the IAQ problem can not be identified or resolved after performing the above, the property manager should contact the DPW representative who in collaboration with DPW Environmental, Health & Safety will take further investigative action. Note: Documentation on complaints and completed Ventilation Log and HVAC Checklist should be available and submitted to DPW upon request.

Ventilation Log

Instructions:

- ☐ Make one copy of this Log for each ventilation unit in your *building/s*
- ☐ Perform the activities in the Ventilation Checklist for each ventilation unit and use this Log to record results.
- ☐ A "No" response requires further attention.

Name _____

Room or Area _____

Date Completed _____

Signature _____

ACTIVITY	NEEDS ATTENTION IF "NO"	OK (DATE)	ACTIVITY	NEEDS ATTENTION IF "NO"	OK (DATE)
1. Outdoor air intake not obstructed	<input type="checkbox"/> Yes <input type="checkbox"/> No		15. Economizer set per specifications	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2. Outdoor air intake clear of nearby pollutant sources	<input type="checkbox"/> Yes <input type="checkbox"/> No		16. Fans supplying outdoor air operate continuously during occupied periods	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3. Outdoor air moving into intake	<input type="checkbox"/> Yes <input type="checkbox"/> No		17. Air distribution functioning per design	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4. Filters in good condition, properly installed, and no major air leaks	<input type="checkbox"/> Yes <input type="checkbox"/> No		18. Air flow direction (relative pressures) okay	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5. Drain pan clean and no standing water	<input type="checkbox"/> Yes <input type="checkbox"/> No		19. Exhaust fan(s) operating	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6. Heating and cooling coil(s) clean	<input type="checkbox"/> Yes <input type="checkbox"/> No		20. Local exhaust fan(s) remove enough air to eliminate odors and chemical fumes	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7. Interior of air handling unit and ductwork clean	<input type="checkbox"/> Yes <input type="checkbox"/> No		21. Exhaust ductwork sealed and in good condition	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8. Mechanical room free of trash and chemicals	<input type="checkbox"/> Yes <input type="checkbox"/> No		22. Measure quantity of outdoor air a. outdoor air supply _____ CFM b. number of occupants served by this unit _____ c. CFM/occupants (a÷b) _____ Meets original design specs?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9. Controls information on hand	<input type="checkbox"/> Yes <input type="checkbox"/> No		23. Compare measured CFM/person (c: above) to Table 1		
10. Clocks, timers, and switches set properly	<input type="checkbox"/> Yes <input type="checkbox"/> No		• Recommendation in Table 1 for this type of area _____		
11. Pneumatic controls okay	<input type="checkbox"/> Yes <input type="checkbox"/> No		• Meets recommendation?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12. Outdoor air damper operating properly	<input type="checkbox"/> Yes <input type="checkbox"/> No				
13. Freeze-stat reset	<input type="checkbox"/> Yes <input type="checkbox"/> No				
14. Mixed air thermostat set properly	<input type="checkbox"/> Yes <input type="checkbox"/> No				

Activity Number

Notes and Comments



This checklist discusses eight major topic areas:

- [Outdoor Air Intakes](#)
- [System Cleanliness](#)
- [Controls for Outdoor Air Supply](#)
- [Air Distribution](#)
- [Exhaust Systems](#)
- [Quantity of Outdoor Air](#)
- [Adequacy of Outdoor Air Supply](#)
- [How to Measure Air Flow](#)

[Ventilation Log](#)

(a printable 667KB PDF file)

Instructions:

1. Read the [IAQ Background](#).
2. Make one copy of the [Ventilation Log](#) for each ventilation unit in your school. *Buildings*
3. Complete each activity for each ventilation unit and note the status of each activity on the [Ventilation Log](#).
4. Return the [Ventilation Logs](#) to the IAQ Coordinator and keep a copies for future reference.



Ventilation Checklist and Log

Schools use a variety of methods for ventilating the building with outdoor air: 1) mechanically-based systems such as unit ventilators, central HVAC systems, and central exhaust systems, and; 2) passive systems that rely on operable windows, air leaks, wind, and the stack effect (the tendency of warm air to rise).

The majority of the Ventilation Checklist/Log activities apply mainly to mechanical ventilation systems, and are designed to accomplish two functions:

- Ensure that the ventilation system is clean, and
- Ensure that an adequate amount of outdoor air is supplied to occupied areas.

Many of these activities should be performed by individuals with appropriate training in mechanical systems and safety procedures. Most activities can be performed with basic maintenance tools, but Activity 22 will require airflow measurement equipment that you may not have. The section [How to Measure Airflow](#), at the back of this Checklist, describes the type of equipment used to measure airflow. The IAQ Coordinator has information on how this equipment can be obtained (Appendix C of the Coordinator's Guide). Make an effort to obtain this equipment before conducting Activity 17. Supplying an adequate amount of outdoor air to an occupied area is necessary for good indoor air quality, and measuring airflow can only be done correctly with equipment that can reliably tell you if you're getting the proper amount of outdoor air (visual inspection or feeling for air movement is not sufficient).

Activities 17-21 can be applied to passive ventilation systems. For activities that do not apply, place a "NA" in the date column of the [Ventilation Log](#).

Your school most likely has multiple units and systems, so be sure to perform the activities and complete the [Ventilation Log](#) for each unit. The activities are listed in a purposeful order to prevent having to repeat activities for a given unit as the inspection progresses. The following is a recommended process for saving time in performing the activities:

Activities 1-3

Perform these activities for all outdoor air intakes while outside the building, and mark the results on the [Ventilation Log](#) for each unit.

Activities 4-12

Perform these activities as a set on each ventilation unit while you're in the room and the unit is open.

Activities 13-16

Perform these ventilation control system activities as required by your situation.

Activities 17-21

Perform these air distribution and exhaust system activities as required by your situation.

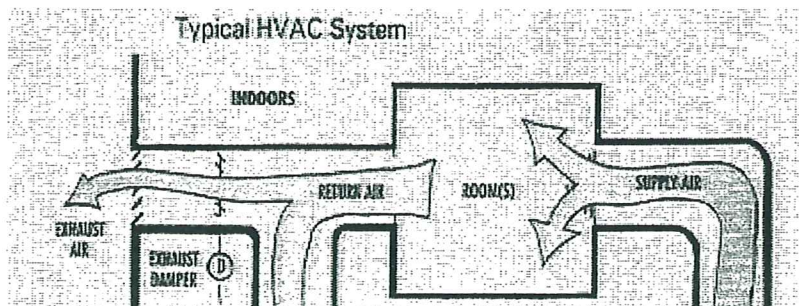
Activities 22-23

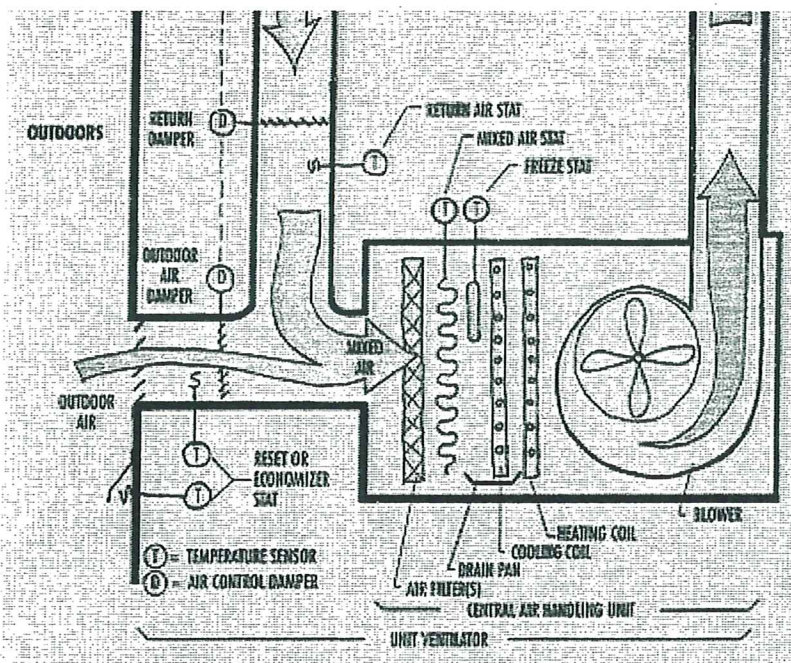
Perform these activities regarding the quantity of outdoor air on all units while you have the airflow measurement equipment available.

All of these activities are described in the information following the Log. For more detailed information see [Building Air Quality: A Guide for Building Owners and Facility Managers](#) (EPA-400-1-91-033) listed in Appendix I of the IAQ Coordinator's Guide.

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Explanatory Information for Ventilation Log Items

OUTDOOR AIR INTAKES

If outdoor air intakes are deliberately blocked or become clogged with dirt or debris, areas they serve are likely to get insufficient outdoor air. Students or staff might experience stuffy or stagnant air, or develop health problems from exposure to accumulated pollutants.

- ☐ On a small floor plan (e.g., a fire escape floor plan), mark the locations of outdoor air intakes, based on mechanical plans (if available) and your observations while performing these activities.
- ☐ Obtain chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) before performing Activity 3. For more information on chemical smoke, see [How to Measure Airflow](#), at the end of this Checklist.
- ☐ Ensure that the ventilation system is on and operating in "occupied" mode.

1. Ensure that outdoor air intakes are unobstructed.

- ☐ Check the intakes from outside the school building for obstructions, such as debris, clogged screens, or make-shift covers (e.g., boards or plastic).
- ☐ Remove any obstructions.
- ☐ Install corrective devices if snowdrifts or leaves often block an intake.

2. Ensure that outdoor air intakes are clear of nearby pollutant sources.

- ☐ Check the intakes from outside the school building to confirm that pollutant sources are not located near outdoor air intakes:
 - At ground level, look for dumpsters, loading docks, and bus-idling areas. *car/truck*
 - At roof level, look for plumbing vents, exhaust outlets (such as kitchen, toilet, or laboratory exhaust fans), puddles on the roof, and mist from air-conditioning cooling towers.
- ☐ Resolve problems due to pollutants near intakes:
 - Remove sources, where possible (for example, move a dumpster to another location).
 - Separate the source from the intake (for example, add another pipe section to raise a nearby exhaust outlet above the intake).

- Change operating procedures (for example, turn off vehicles instead of idling at loading docks and bus stands).

3. Confirm that outdoor air is entering the system intake.

- ☐ Use chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) to show whether air is moving into the intake grille.

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SYSTEM CLEANLINESS

Accumulated dirt can interfere with the proper operation of the ventilation system and lead to underventilation, uncomfortable temperatures, less efficient operation (higher utility bills), more maintenance, and decreased life expectancy of equipment. Air filters are intended primarily to prevent dirt and dust from accumulating in the HVAC system. If filters are not properly selected and maintained, built-up dirt in coils and ducts can provide a habitat for microbiological growth. Filters that are clogged with dirt restrict the flow of air through the HVAC system. If filters "blow out" and allow the passage of unfiltered air, dirt can accumulate on coils (producing a need for more frequent cleaning) and reduce the efficiency of the heating and/or cooling plant. It is much less expensive to trap dirt with properly-maintained filters than to remove it from ductwork, coils, fan blades, and other HVAC system components.

WARNING: Do not clean dirty or biologically contaminated system components when the system is operating and the building is occupied.

WARNING: If there is visible biological growth, such as mold, minimize your exposure to air in the interior of ducts or other HVAC equipment. Use proper respiratory protection; obtain expert advice about the kind of respiratory protection to use and how to use it.

4. Inspect air filters on ventilation equipment.

- ☐ Install new filters as needed. Shut off ventilation system fans when replacing associated filters so that dirt will not blow downstream. Vacuum the filter area before installing the new filter.
- ☐ Confirm that filters fit properly in their tracks, with no major air leaks that would allow air to bypass (flow around) the air filter.
- ☐ Confirm that filters are installed in the proper direction for airflow.

5. Ensure that condensate drain pans are clean and drain properly.

- Drain pans should slant toward the drain so they do not collect and hold water.

6. Ensure that heating and cooling coils are clean.

7. Ensure that air handling unit(s) (air mixing chambers, coils, and fan blades) and duct interiors are clean.

8. Ensure that the mechanical rooms are free of trash and chemicals.

- ☐ Check mechanical room for unsanitary conditions, leaks, or spills.
- ☐ Confirm that mechanical rooms and air mixing chambers are not used to store trash or chemical products and supplies.

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CONTROLS FOR OUTDOOR AIR SUPPLY

This group of activities is for ventilation systems that use fans or blowers to supply outdoor air to one or more rooms within a school. The primary objectives that you should keep in mind as you perform these activities are:

- To ensure that air dampers are always at least partially open (minimum position) during occupied hours, and
- To ensure that the minimum position provides an adequate amount of outdoor air for the occupants.

These activities are fairly generic, and apply to most ventilation systems. See the figures in the [IAQ Backgrounder](#) for more information.

Activities 9-11 generally serve multiple ventilation units, while activities 12-16 are related and performed at each individual ventilation unit. Based on your equipment and experience, perform as many of the activities and make as many indicated repairs as possible. Discuss the need for additional help for any uncompleted activities or repairs with your IAQ Coordinator.

9. Gather controls information.

Your ventilation controls may be uniquely designed, and since there are many different types and brands of control components, it can be very helpful if you:

- Gather and read any controls specifications, as-built mechanical drawings, and controls operations manuals that you may have.
- Contact the system installer or HVAC maintenance contractor to obtain controls information that is missing from your files.

10. Check Clocks, Timers, and Seasonal Switches.

- ☐ Confirm that summer-winter switches are in the right position.
- ☐ Confirm that time clocks read the correct time.
- ☐ Confirm that time clock settings fit the actual schedule of building use (night/weekend set-back and set-up).

11. Check pneumatic control system components (if any).

- ☐ Test the line pressure at both the occupied (day) setting and the unoccupied (night) setting to determine whether the overall system pressure is appropriate.
- ☐ Confirm that the line dryer is preventing moisture buildup.
- ☐ Check the control system filters. The filter at the compressor inlet should be changed periodically in keeping with the compressor manufacturer's recommendation (for example, when you blow down the tank).
- ☐ Ensure that the line pressure at each thermostat and damper actuator is at the proper level (no leakage or obstructions).
- ☐ Repair or replace defective components.

12. Check outdoor air damper operation.

Before continuing, the air temperature in the indoor area(s) served by this outdoor air damper must be within the normal operating range, and ensure that the outdoor air damper is visible for your inspection.

- ☐ Turn off the air handler connected to the outdoor air damper and confirm that the damper fully closes within a few minutes.
- ☐ Turn on the air handler and confirm that the outdoor air damper opens at least partially with little or no delay.
- ☐ Set the room thermostat as follows, and observe the damper for movement (damper should go to its minimum position, but not completely closed):
 - If in heating mode, set the room thermostat to 85°F.
 - If in cooling mode, set the room thermostat to 60°F, mark the current setting of the mixed air thermostat, and set it to a low setting (about 45°F).
- ☐ If the outdoor air damper does not move:
 - Confirm that the damper actuator is linked to the damper shaft and that any linkage set screws or bolts are tight.
 - Confirm that rust or corrosion are not preventing free movement.
 - Confirm that either electrical wires or pneumatic tubing is connected to the damper actuator.
 - Reset thermostat(S) to appropriate temperature(s).

Proceed to Activities 13-16 if the damper seems property operating.

NOTE: The minimum damper setting, adjusted with a nut or a knob, may have to be adjusted to allow a larger damper opening if the amount of outdoor air supply measured in Activity 22 is not adequate for the number of occupants being served.

Unit Ventilators are sometimes specified to operate under one of the following ASHRAE sequences:

- **Cycle I:** Except during warm-up stage (outdoor air damper closed), Cycle I supplies 100% outdoor air at all times.
- **Cycle II:** During the heating stage, Cycle II supplies a set minimum quantity of outdoor air. Outdoor air is gradually increased, as required for cooling. During warm-up, the outdoor air damper is closed. (Typical sequence for northern climates.)
- **Cycle III:** During the heating, ventilating and cooling stages, Cycle III supplies a variable amount of outdoor air as required to maintain a fixed temperature (typically 55°F) entering the heating coil. When heat is not required, this air is used for cooling. During warmup, the outdoor air damper is closed. (Typical sequence for southern climates, With adaptations for mechanical cooling.)

The following four items may be responsible for keeping outdoor air dampers closed during the normal occupied cycle.

13. Confirm freeze-stat condition.

HVAC systems with water coils need protection from freezing. The freeze-stat may close the outdoor air damper and disconnect the supply air when tripped. The typical trip range is 35°F to 42°F.

- If the freeze-stat has a manual reset button (usually red), depress the button. If a click is heard, the freeze-stat was probably tripped. Consider replacing manual reset freeze-stats with automatic reset freeze-stats.
- If the freeze-stat has an automatic reset, disconnect power to the controls and test for continuity across the terminals.

14. Check mixed air thermostat.

- The mixed air stat for heating mode should be set no higher than 65°F.
- The mixed air star for cooling mode should be set no lower than the room thermostat setting.

15. Check air economizer setting.

Economizers use varying amounts of cool outdoor air to assist with the cooling load of the room or rooms. There are two types of economizers, dry-bulb and enthalpy. Dry-bulb economizers vary the amount of outdoor air based on outdoor air temperature, and enthalpy economizers vary the amount of outdoor air based on outdoor air temperature and humidity level.

- ☐ Confirm proper settings based on design specifications or local practices (dry-bulb setting typically 65°F or lower).
- ☐ Check the sensor to make sure that it is shielded from direct sunlight.

16. Confirm that fans operate continuously during occupied periods.

- Any fan that helps move air from outdoors to indoors must operate continuously during occupied hours, even though the room thermostat is satisfied.
- If the fan shuts off when the thermostat is satisfied, change the control cycle to prevent underventilation.



AIR DISTRIBUTION

Even if enough outdoor air is brought into a school building, IAQ problems can develop if the outdoor air is not properly distributed. In such cases, underventilation occurs in particular areas of the building rather than being widespread. Problems with air distribution are most likely to occur in areas where:

- Ventilation equipment is malfunctioning.
- Room layouts have been altered without adjusting the HVAC system.

- The population of a room or zone has grown without adjustment to the HVAC system.
- Air pressure differences move air contaminants from outdoors to indoors and transport them within buildings.

In schools with mechanical ventilation equipment, fans are the dominant influence on pressure differences and air flows. In schools without mechanical ventilation equipment, natural forces (wind and stack effect) primarily influence airflows.

To prevent infiltration of outdoor air and soil gas (e.g., radon), mechanically-ventilated buildings are often designed to maintain a higher air pressure indoors than outdoors, which is known as positive pressurization (See [Exhaust Systems](#) and [How to Measure Airflow](#) for a description of building pressurization). At the same time, exhaust fans control indoor contaminants by keeping rooms such as smoking lounges, bathrooms, kitchens, and laboratories under negative pressure compared to surrounding rooms. "Negative pressure" and "positive pressure" describe pressure relationships. A room can operate under negative pressure as compared to neighboring rooms, but at the same time it may be positive compared to outdoors.

17. Check air distribution.

Verify that air pathways in the original ventilation system design continue to function.

- ☐ Check to see whether operable windows have been replaced by windows that cannot be opened.
- ☐ Check to see whether passive gravity relief ventilation systems and transfer grilles between rooms and corridors are functioning. If they are closed off or blocked to meet modern fire codes, consult with a professional engineer for remedies.
- ☐ Verify that every occupied space has a supply of outdoor air (mechanical system or operable windows).
- ☐ Confirm that supplies and returns are open and unblocked. If outlets have been blocked intentionally to correct drafts or discomfort, investigate and correct the cause of the discomfort and reopen the vents.
- ☐ If you discovered areas with no source of outside air, modify the HVAC system to correct the problem.
- ☐ Check for barriers, such as room dividers, large free-standing blackboards or displays, or bookshelves, that could block movement of air in the room, especially if they block air vents.

18. Check air flow direction.

- ☐ Confirm that the system, including any exhaust fans, is operating on the occupied cycle when doing this activity.
- Where outdoor contaminant sources have been identified, use chemical smoke to determine whether the air flows out of the building through leaks in nearby windows, doors, or other cracks and holes in exterior walls.
- Use chemical smoke to determine whether air flows out of the building through below-grade cracks and holes (e.g., floor joints, pipe openings).



EXHAUST SYSTEMS

Exhaust systems are used to remove air that contains contaminants, including odors. Some HVAC designs also rely on the operation of exhaust fans to create negative pressure that draws outdoor air into the building through windows and gaps in the building envelope.

19. Confirm that exhaust fans are operating.

- Use chemical smoke to confirm that air is flowing into the exhaust grille(s).

20. Verify that local exhaust fans remove enough air to eliminate odors and chemical fumes.

If the fan is intended to exhaust the entire room, stand outside the room with the door slightly open and use chemical smoke to confirm that air is being drawn into the room from locations both high and low in the door opening (see [How to Measure Airflow](#)).

If the fan is running, but air isn't flowing toward the exhaust intake (or too little air is moving to do the job), check for the following possibilities:

- The backdraft damper at the exhaust outlet does not open.
- Obstructions in the ductwork.
- Leaky or disconnected ductwork.

- Broken fan belt.
- Motor running backwards.
- Design problems (e.g., undersized fan)

21. If the exhaust fan is located close to the contaminant source, rather than on the roof, and exhaust air is ducted through the building under positive pressure.

- Confirm that the exhaust ductwork is sealed and in good condition.

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QUANTITY OF OUTDOOR AIR

22. Measure quantity of outdoor air per person.

See [How to Measure Airflow](#) at the end of this Checklist for techniques on measuring outdoor air supply.

Measure the quantity of outdoor air supplied either to or from each ventilation unit. Use the [Ventilation Log](#) to calculate the quantity of outside air per person being provided to occupants (22a. on the [Ventilation Log](#)).

Count or calculate the number of occupants served by the ventilation unit under consideration (22b. on the [Ventilation Log](#)).

Divide the quantity of outdoor air supplied by the number of occupants served for the ventilation unit under consideration (22a divided by 22b on the [Ventilation Log](#)).

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ADEQUACY OF OUTDOOR AIR SUPPLY

23. Compare the measured outdoor air per person to [Table 1](#)

In the first column of [Table 1](#), find the listing for the type of area that is served by the unit you are evaluating.

Check the second column to see if the occupancy for each 1,000 square feet that the ventilation unit serves is no greater than the occupancy assumed for the recommendations.

Compare the recommended ventilation in the third column of [Table 1](#) to the calculated outdoor air per person from Activity 22.

If the calculated airflow is below the recommendations in [Table 1](#), it may be that the school was designed to meet a lower standard that was in effect at the time the school was built. If you have design specifications for the system or know code requirements in effect at the time of construction, compare the measured outdoor air to this specification. Repair the system to meet the design specification, if necessary.

If the school was designed to a lower standard and cannot meet the recommended levels in [Table 1](#), discuss with the IAQ Coordinator means for increasing ventilation:

- Retrofitting the ventilation system for increased capacity.
- Opening windows (Caution: Consider potential ventilation problems that this may cause in other parts of the building).
- Make any repairs permanent and take any other measures that appear to help ensure adequate outdoor air in the future. These improvements will probably require the services of a professional engineer.

Table 1: Selected ASHRAE Ventilation Recommendations

Type of Area	Occupancy (people/1000 ft ²)	CFM/person
Instructional Areas		
Classrooms	50	15
Laboratories	30	20
Music rooms	50	15
Training shops	30	20
Staff Areas		

Conference rooms	50	20
Offices	70	20
Smoking lounges	7	60
Bus garage: 1.5 CFM per square foot of floor area. Distribution among people must consider worker location and concentration of running engines; stands where engines are run must incorporate systems for positive engine exhaust withdrawal. Contaminant sensors may be used to control ventilation.		
Assembly Rooms		
Auditoriums	150	15
Libraries	20	20
Gymnasiums		
Spectator areas	150	15
Playing floor	30	20
Food and Beverage Service		
Cafeteria	100	20
Kitchen	20	15
Additional airflow may be needed to provide make-up air for hood exhaust(s). The sum of the outdoor air and transfer air of acceptable quantity from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 CFM/square foot.		
Miscellaneous		
Nurse's offices (patient areas)	10	25
Corridors:	0.1 CFM/square foot	
Locker rooms:	0.5 CFM/square foot	
Restroom:	50 CFM/urinal or water closet	
Source: ASHRAE Standard 62-1989, Ventilation for Acceptable Air Quality		

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HOW TO MEASURE AIRFLOW

This section provides basic guidance and options for determining air movement and measuring outdoor air supply. It is divided into three sections:

- Using chemical smoke to determine air flow direction.
- Measuring airflow to determine outdoor air supply quantity.
- Estimating outdoor air quantity using carbon dioxide measurements.

*FOR TEMPERATURE -
SEE VENTILATION WORKSHEET*

1. Using Chemical Smoke to Determine Air Flow Direction

Chemical smoke can be helpful in evaluating HVAC systems, tracking air and pollutant movement, and identifying pressure differentials. Chemical smoke moves from areas of higher pressure to areas of lower pressure if there is an opening between them (e.g., door, utility penetration).

Because it is the same temperature as the surrounding air, chemical smoke is extremely sensitive to air currents. Investigators can learn about airflow patterns by observing the direction and speed of smoke movement. Smoke released near outdoor air intakes will indicate whether air is being drawn into the intake. Puffs of smoke released at the shell of the building (by doors, windows, or gaps) will indicate whether the HVAC systems are maintaining interior spaces under positive pressure relative to the outdoors.

Chemical smoke is available with various dispensing mechanisms, including smoke "bottles," "guns," "pencils," or "tubes." The dispensers allow smoke to be released in controlled quantities and directed at specific locations. It is often more informative to use a number of small puffs of smoke as you move along an air pathway rather than releasing a large amount in a single puff.

Caution: Chemical smoke devices use titanium tetrachloride to produce smoke. While the chemicals forming the smoke normally are not hazardous in the small quantities produced during testing, avoid inhaling smoke from smoke devices. Concentrated fumes from smoke devices are very corrosive.

Determining Air Movement From Diffusers And Grilles

Puffs of smoke released near HVAC vents give a general idea of airflow. (Is it in or out? Vigorous? Sluggish? No flow?) This is helpful in

evaluating the supply and return system and determining whether ventilation air actually reaches the breathing zone. (For a variable air volume system, be sure to take into account how the system is designed to modulate. It could be on during the test, but off for much of the rest of the day.) "Short-circuiting" occurs when air moves directly from supply diffusers to return grilles, instead of mixing with room air in the breathing zone. If a substantial amount of air short-circuits, occupants may not receive adequate supplies of outdoor air and source emissions may not be diluted sufficiently.

2. Measuring Outdoor Air Supply Quantity.

This section describes methods for determining the amount of outdoor air being supplied by a single ventilation unit using either a flowhood or air velocity measurement device. These are general instructions for measuring airflow. Follow the instructions provided by the manufacturer of your measuring equipment.

Step 1. Determine Airflow Quantity

Using a Flow Hood

Flowhoods measure airflow in cubic feet per minute (CFM) at a diffuser or grill. Taking the measurement is simply a matter of holding the hood up to the diffuser and reading the airflow value. Follow the instructions supplied with the flowhood regarding use, care, and calibration.

Using Velocity Measurements

For information on measuring air velocity using a Pitot tube or anemometer and calculating outdoor air supply, see the instructions supplied with the equipment.

Airflow in large ductwork can be estimated by measuring air velocity using a Pitot tube with a differential pressure gauge or an anemometer. (See the IAQ Coordinator for sources of these devices.)

- Measure the air velocity in the ductwork and calculate the outdoor airflow in cubic feet per minute (CFM) at the outdoor air intake of the air handling unit or other convenient location.
- Enter the calculated outdoor air supply in the Ventilation Log.

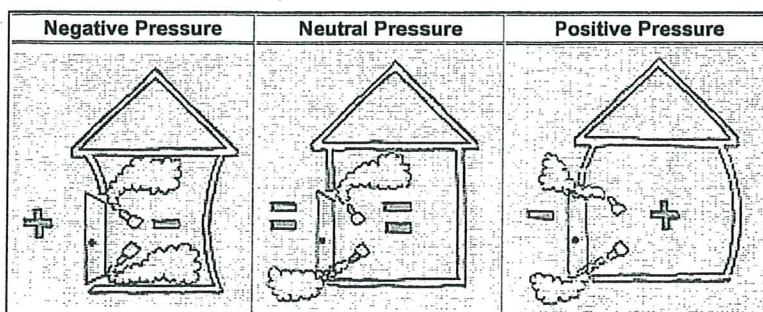
For Systems Without Mechanically-Supplied Outdoor Air

If your system does not have mechanically supplied outdoor air, you can estimate the amount of outdoor air infiltrating the area. Estimate air infiltrating by measuring the quantity of air exhausted by exhaust fans serving the area.

- Using a small floor plan, such as a fire escape map, mark the areas served by each exhaust fan.
- Measure airflow at grilles or exhaust outlets using a flow hood. Determine the airflow in ductwork by using a Pitot tube with a differential pressure gauge or an anemometer.
- Add the airflows (in CFM) from all exhaust fans serving the area you are measuring and enter the measurement in the Ventilation Log.

A room can be positively or negatively pressurized when compared to the spaces surrounding it. These spaces include another room, a corridor, or outdoors. To determine whether a room is positively or negatively pressurized, or neutral, release puffs of smoke near the top and bottom of a slightly opened door or window, and observe the direction of flow. Example: If the smoke flows inward at both the top and bottom of a slightly opened door, the room is negatively pressurized when compared to the space on the other side of the door.

Negative pressurization may cause problems with natural draft combustion appliances, or cause outdoor pollutants such as pollens or vehicle exhaust in loading docks to be drawn into the building through openings.



Step 2. Determine Occupancy

Count the number of students and staff located in areas served by the air handling unit (called the occupied zone). If you are estimating infiltration using exhaust fan airflows, count individuals in the area you have determined are affected by the fan(s) in Step 1.

- Using a small floor plan, mark the occupied zone served by the unit. In areas served by unit ventilators, an occupied zone is probably an individual classroom. In areas served by large air handling units, an occupied zone may include several rooms. A large gymnasium or other room may be served by several air handling units.
- Estimate the number of occupants in the occupied zone, including students, teachers, other staff members, volunteers and visitors.

Step 3. Calculate Outdoor Air Per Person

- Use the equation below (the equation also appears on the Ventilation Log) to calculate average ventilation rates in CFM/person.

$$\frac{\text{Outdoor air (CFM)}}{\text{Number of occupants}} = \text{Outdoor air (average CFM/person)}$$

3. Estimating Outdoor Air Using Carbon Dioxide Measurements

Carbon dioxide (CO₂) is a normal constituent of the atmosphere. Exhaled breath from building occupants and other sources increase indoor CO₂ levels above that of the outdoor air. CO₂ should be measured with a direct-reading meter (See Appendix B for sources of CO₂ meters). Use the meter according to manufacturer's instructions. Indoor CO₂ concentrations can, under some test conditions, be used to access outdoor air ventilation. Comparison of peak CO₂ readings between rooms and between air handler zones may help to identify and diagnose various building ventilation deficiencies.

Step 1. Estimate quantity of outdoor air supply.

CO₂ readings, with minimal delays between readings, can be taken at supply outlets or air handlers to estimate the percentage of outdoor air in the supply airstream.

The percentage or quantity of outdoor air is calculated using CO₂ measurements as shown below.

Outdoor air (90%) = (CR-CS) divided by (CR-CO) x 100

Where: CS = PPM CO₂ in the supply air (if measured in a room), or in the mixed air (if measured at an air handler)

CR = PPM of CO₂ in the return air

CO = PPM of CO₂ in the outdoor air (Typical range is 300-450 ppm)

All these concentrations must be measured, not assumed.

To convert the outdoor air percent to an amount of outdoor air in cubic feet per minute, use the following calculation:

Outdoor air (CFM) = Outdoor air (percent) divided by 100 x total airflow (CFM)

The number used for total airflow may be the air quantity supplied to a room or zone, the capacity of an air handler, or the total airflow of the HVAC system. However, the actual amount of airflow in an air handler is often different from the quantity in design documents. Therefore only measured airflow is accurate.

Step 2. Measure CO₂ levels in the area served by a given unit or exhaust fan(s) or in an area without any mechanical ventilation.

The number of occupants, time of day, position of windows and doors, and weather should be noted for each period of CO₂ testing.

- Measurements taken to evaluate the adequacy of ventilation should be made when concentrations are expected to peak. It may be

helpful to compare measurements taken at different times of day. Classroom CO₂ levels will typically rise during the morning, fall during the lunch period, then rise again, reaching a peak in mid-afternoon. Sample in the mid- to late-afternoon

- Take several CO₂ measurements in the area under consideration. CO₂ measurements for ventilation should be collected away from any source that could directly influence the reading (e.g., hold the sampling device away from exhaled breath)
- Take several measurements outdoors
- For systems with mechanically supplied outdoor air, take one or more readings at the following locations:
 - At the supply air vent
 - In the mixed air (if measured at an air handler)
 - In the return air

Step 3. Note whether CO₂ levels are high.

- Note locations with CO₂ concentrations of 1,000 ppm or higher. Elevated CO₂ indicates that there is not enough outdoor air for the number of people in the space (based on ASHRAE Standard 62, see Appendix I)
- Note that there may still be underventilation problems in rooms with peak CO₂ concentrations below 1,000 PPM. CO₂ is produced by human respiration (breathing), and concentrations can change rapidly as people move in and out of a room. Four to six hours of continuous occupancy are often required for CO₂ to approach peak levels

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<http://www.epa.gov/iaq/schools/tfs/ventilat.html>
Created: June 1998; Revised: October 2, 2000



Ventilation Worksheet

Building Name: _____ File Number: _____

Address: _____

Completed by (name): _____ Date: _____

This worksheet is designed for use with the **Zone/Room Record**. Appendix A provides guidance on methods of estimating the amount of ventilation (outdoor) air being introduced by a particular air handling unit. Appendix B discusses the ventilation recommendations of ASHRAE Standard 62-1989, which was developed for the purpose of preventing indoor air quality problems. Formulas are given below for calculating outdoor air quantities using thermal or CO₂ information.

The equation for calculating outdoor air quantities **using thermal measurements** is:

$$\text{Outdoor air (in percent)} = \frac{T_{\text{return air}} - T_{\text{mixed air}}}{T_{\text{return air}} - T_{\text{outdoor air}}} \times 100$$

Where: T = temperature in degrees Fahrenheit

The equation for calculating outdoor air quantities **using carbon dioxide measurements** is:

$$\text{Outdoor air (in percent)} = \frac{C_s - C_r}{C_o - C_r} \times 100$$

Where: C_s = ppm of carbon dioxide in the supply air (if measured in a room), or

C_s = ppm of carbon dioxide in the mixed air (if measured at an air handler)

C_r = ppm of carbon dioxide in the return air

C_o = ppm of carbon dioxide in the outdoor air

Using the table below to estimate the ventilation rate in any room or zone. Note: ASHRAE 62-1989 generally states ventilation (outdoor air) requirements on an occupancy basis; for a few types of spaces, however, requirements are given on a floor area basis. Therefore, this table provides a process of calculating ventilation (outdoor air) on either an occupancy or floor area basis.

Zone/Room	Percent of Outdoor Air	Total Air Supplied to Zone/Room (cfm)	Peak Occupancy (number of people) or Floor Area (square feet)	D = $\frac{B}{C}$ Total Air Supplied Per Person (or per square foot area)	E = (A x 100) x D Outdoor Air Supplied Per Person (or per square foot area)
	A	B	C	D	E

It is generally easy to obtain a good temperature reading in the outdoor air and return airstreams. To obtain a good average temperature reading of the mixed airstream, a large number of measurements must be taken upstream of the point at which the airstream is heated or cooled. This may be difficult or impossible in some systems.

The percentage or quantity of outdoor air is calculated using thermal measurements as shown to the right.

Methodology: Carbon Dioxide Measurements

CO₂ readings can be taken at supply outlets or air handlers to estimate the percentage of outdoor air in the supply airstream. The percentage or quantity of outdoor air is calculated using CO₂ measurements as shown to the right.

Using the Results

The results of this calculation can be compared to the building design specifications, applicable building codes, or ventilation recommendations such as ASHRAE 62-1989 (see page 136 in *Appendix B*) to see whether under-ventilation appears to be a problem.

AIR CONTAMINANT CONCENTRATIONS

Volatile Organic Compounds (VOCs)

Hundreds of organic (carbon-containing) chemicals are found in indoor air at trace levels. VOCs may present an IAQ problem when individual organics or mixtures exceed normal background concentrations.

Methodology: Total Volatile Organic Compounds (TVOCs)

Several direct-reading instruments are

ESTIMATING OUTDOOR AIR QUANTITIES

Using Thermal Mass Balance

$$\text{Outdoor air (percent)} = \frac{T_{\text{return air}} - T_{\text{mixed air}}}{T_{\text{return air}} - T_{\text{outdoor air}}} \times 100$$

Where: T = temperature (degrees Fahrenheit)

Using Carbon Dioxide Measurements

$$\text{Outdoor air (\%)} = \frac{C_s - C_R}{C_o - C_R} \times 100$$

Where: C_s = ppm CO₂ in the supply air (if measured in a room), or
C_s = ppm of CO₂ in the mixed air (if measured at an air handler)
C_R = ppm of CO₂ in the return air
C_o = ppm of CO₂ in the outdoor air

(All these concentrations must be measured, not assumed.)

Converting Percent To CFM

$$\text{Outdoor air (in cfm)} = \frac{\text{Outdoor air (percent)}}{100} \times \text{total airflow (cfm)}$$

Where: cfm = cubic feet per minute

The number used for total airflow may be the air quantity supplied to a room or zone, the capacity of an air handler, or the total airflow of the HVAC system. Note: The actual amount of airflow in an air handler is often different from the quantity in design documents.

available that provide a low sensitivity "total" reading for different types of organics. Such estimates are usually presented in parts per million and are calculated with the assumption that all chemicals detected are the same as the one used to calibrate the instrument. A photoionization detector is an example of a direct-reading instrument used as a screening tool for measuring TVOCs.

A laboratory analysis of a sorbent tube can provide an estimate of total solvents in the air. Although methods in this category report "total volatile organic compounds" (TVOCs) or "total hydrocarbons" (THC),

Indoor Air Quality Complaint Form

This form can be filled out by the building occupant or by a member of the building staff.

Occupant Name: _____ Date: _____

Department/Location in Building: _____ Phone: _____

Completed by: _____ Title: _____ Phone: _____

This form should be used if your complaint may be related to indoor air quality. Indoor air quality problems include concerns with temperature control, ventilation, and air pollutants. Your observations can help to resolve the problem as quickly as possible. Please use the space below to describe the nature of the complaint and any potential causes.

We may need to contact you to discuss your complaint. What is the best time to reach you? _____

So that we can respond promptly, please return this form to: _____

IAQ Manager or Contact Person

Room, Building, Mail Code

OFFICE USE ONLY

File Number: _____ Received By: _____ Date Received: _____

Dates (from): _____ (to): _____

Completed by (name): _____

[illegible]

Occupant Interview

Page 1 of 2

Building Name: _____ File Number: _____

Address: _____

Occupant Name: _____ Work Location: _____

Completed by: _____ Title: _____ Date: _____

Sections 4 discusses collecting and interpreting information from occupants.

SYMPTOM PATTERNS

What kind of symptoms or discomfort are you experiencing?

Are you aware of other people with similar symptoms or concerns? Yes _____ No _____

If so, what are their names and locations? _____

Do you have any health conditions that may make you particularly susceptible to environmental problems?

- ☐ contact lenses ☐ chronic cardiovascular disease ☐ undergoing chemotherapy or radiation therapy
- ☐ allergies ☐ chronic respiratory disease ☐ immune system suppressed by disease or other causes
- ☐ chronic neurological problems

TIMING PATTERNS

When did your symptoms start?

When are they generally worst?

Do they go away? If so, when?

Have you noticed any other events (such as weather events, temperature or humidity changes, or activities in the building) that tend to occur around the same time as your symptoms?

DO NOT ASK

the occupant does not have to answer this - it is personal or confidential however, you let the know they don't have to know but the still of info - ok

Occupant Diary

Occupant Name: _____ Title: _____ Phone: _____

Location: _____ File Number: _____

On the form below, please record each occasion when you experience a symptom of ill-health or discomfort that you think may be linked to an environmental condition in this building.

It is important that you record the time and date and your location within the building as accurately as possible, because that will help to identify conditions (e.g., equipment operation) that may be associated with your problem. Also, please try to describe the severity of your symptoms (e.g., mild, severe) and their duration (the length of time that they persist). Any other observations that you think may help in identifying the cause of the problem should be noted in the "Comments" column. Feel free to attach additional pages or use more than one line for each event if you need more room to record your observations.

Section 6 discusses collecting and interpreting occupant information.

Time/Date	Location	Symptom	Severity/Duration	Comments

Hypothesis Form

Page 1 of 2

Building Name: _____ File Number: _____

Address: _____

Completed by: _____

Complaint Area (may be revised as the investigation progresses):

Complaints (e.g., summarize patterns of timing, location, number of people affected):

HVAC: Does the ventilation system appear to provide adequate outdoor air, efficiently distributed to meet occupant needs in the complaint area? If not, what problems do you see?

Is there any apparent pattern connecting the location and timing of complaints with the HVAC system layout, condition or operating schedule?

Pathways: What pathways and driving forces connect the complaint area to locations of potential sources?

Are the flows opposite to those intended in the design? _____

Sources: What potential sources have been identified in the complaint area or in locations associated with the complaint area (connected by pathways)?

Is the pattern of complaints consistent with any of these sources? _____

Hypothesis Form

Page 2 of 2

Hypothesis: Using the information you have gathered, what is your best explanation for the problem?

Hypothesis testing: How can this hypothesis be tested?

If measurements have been taken, are the measurement results consistent with this hypothesis?

Results of Hypothesis Testing:

Additional Information Needed:

Pollutant and Source Inventory

Page 1 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Sections 2, 4 and 6 discuss pollutant sources. Appendix A provides guidance on common measurements.

Source Category	Checked	Needs Attention	Location	Comments
SOURCES OUTSIDE BUILDING				
Contaminated Ambient Air				
Pollen, dust				
Industrial contaminants				
General vehicular contaminants				
Emissions from Nearby Sources				
Vehicle exhaust (parking areas, loading docks, roads)				
Dumpsters				
Re-entrained exhaust				
Debris near outside air intake				
Soil Gas				
Radon				
Leaking underground tanks				
Sewage smells				
Pesticides				

Pollutant and Source Inventory

Page 2 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
Moisture or Standing Water				
Rooftop				
Crawlspace				
EQUIPMENT				
HVAC System Equipment				
Combustion gases				
Dust, dirt, or microbial growth in ducts				
Microbial growth in drip pans, chillers, humidifiers				
Leaks of treated boiler water				
Non HVAC System Equipment				
Office equipment				
Supplies for equipment				
Labratory equipment				

Pollutant and Source Inventory

Page 3 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
HUMAN ACTIVITIES				
Personal Activities				
Smoking				
Cosmetics (odors)				
Housekeeping Activities				
Cleaning materials				
Cleaning procedures (e.g., dust from sweeping, vacuuming)				
Stored supplies				
Stored refuse				
Maintenance Activities				
Use of materials with volatile compounds (e.g., paint, caulk, adhesives)				
Stored supplies with volatile compounds				
Use of pesticides				

Pollutant and Source Inventory

Page 4 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
BUILDING COMPONENTS/FURNISHINGS				
Locations Associated with Dust or Fibers				
Dust-catching area (e.g., open shelving)				
Deteriorated furnishings				
Asbestos-containing materials				
Unsanitary Conditions/Water Damage				
Microbial growth in or on soiled or water-damaged furnishings				

Pollutant and Source Inventory

Page 5 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source	Category	Checked	Needs Attention	Location	Comments
Chemicals Released From Building Components or Furnishings					
Volatile compounds					
OTHER SOURCES					
Accidental Events					
Spills (e.g., water, chemicals, beverages)					
Water leaks or flooding					
Fire damage					

Pollutant and Source Inventory

Page 6 of 6

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
Special Use/Mixed Use Areas				
Smoking lounges				
Food preparation areas				
Underground or attached parking garages				
Laboratories				
Print shops, art rooms				
Exercise rooms				
Beauty salons				
Redecorating/Repair/Remodeling				
Emissions from new furnishings				
Dust, fibers from demolition				
Odors, volatile compounds				

Chemical Inventory

Building Name: _____ File Number: _____

Address: _____

Completed by: _____ Phone: _____

The inventory should include chemicals stored or used in the building for cleaning, maintenance, operations, and pest control. If you have an MSDS (Material Safety Data Sheet) for the chemical, put a check mark in the right-hand column. If not, ask the chemical supplier to provide the MSDS, if one is available.

Sections 2 and 6 discuss pollutant sources. Section 4 discusses MSDSs.

Date	Chemical/Brand Name	Use	Storage Location(s)	MSDS on file?

Zone Room Record

Building Name: _____ File Number: _____ Date: _____

Address: _____ Completed by: _____ Title: _____

This form is to be used differently depending on whether the goal is to prevent or to diagnose IAQ problems. During the development of a profile, this form should be used to record more general information about the entire building; during an investigation, the form should be used to record more detailed information about the complaint area and areas surrounding the complaint area or connected to it by pathways.

Use the last three columns when underventilation is suspected. Use the **Ventilation Worksheet** and Appendix A to estimate outdoor air quantities. Compare results to the design specifications, applicable building codes, or ventilation guidelines such as ASHRAE 62-1989. (See Appendix A for some outdoor air quantities required by ASHRAE 62-1989.) Note: For VAV systems, minimum outdoor air under reduced flow conditions must be considered.

PROFILE AND DIAGNOSIS INFORMATION				DIAGNOSIS INFORMATION ONLY			
Building Area (Zone/Room)	Use**	Source of Outdoor Air*	Mechanical Exhaust? (Write "No" or estimate cfm airflow)	Comments	Peak Number of Occupants or Sq. Ft. Floor Area**	Total Air Supplied (in cfm)***	Outdoor Air Supplied per Person or per 150 Sq. Ft. Area (in cfm)****

* Sources might include air handling unit (e.g., AHU-4), operable windows, transfer from corridors.

** Underline the information in this column if current use or number of occupants is different from design specifications.

*** Mark the information with a **P** if it comes from the mechanical plans or an **M** if it comes from actual measurements, such as recent test and balance reports.

**** ASHRAE 62-1989 gives ventilation guidance per 150 sq. ft.

Log of Activities and System Operations

Building Name: _____ Address: _____ File Number: _____

Completed by: _____ Title: _____ Phone: _____

On the form below, please record your observations of the HVAC system operation, maintenance activities, and any other information that you think might be helpful in identifying the cause of IAQ complaints in this building. Please report any other observations (e.g., weather, other associated events) think may be important as well.

Feel free to attach additional pages or use more than one line for each event.

Equipment and activities of particular interest:

Air Handler(s): _____

Exhaust Fan(s): _____

Other Equipment or Activities: _____

Date/Time	Day of Week	Equipment Item/Activity	Observations/Comments

This form should be used in combination with a floor plan such as a fire evacuation plan.

Address: _____

Sections 2, 4 and 6 discuss pollutant pathways and driving forces.

List the building areas in which pressure relationships should be controlled. As you inspect the building, put a Y or N in the "Needs Attention" column to show whether the desired air pressure relationship is present. Mark the floor plan with arrows, plus signs (+) and minus signs (-) to show the airflow patterns you observe, using chemical smoke or a micromanometer.

Building areas that appear isolated from each other may be connected by airflow passages such as air distribution zones, utility tunnels or chases, party walls, spaces above suspended ceilings (whether or not those spaces are serving as air plenums), elevator shafts, and crawlspaces. If you are aware of pathways connecting the room to identified pollutant sources (e.g., items of equipment, chemical storage areas, bathrooms), it may be helpful to record them in the "Comments" column, on the floor plan, or both.

[illegible]

[illegible]